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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/463,643	05/01/2000	SHUJI NAKAMURA	NICHIA-00700	6608
7590 02/10/2004				
ARTHUR R. CRAWFORD NIXON & VANDERHYE P.C. 8TH FLOOR 1100 NORTH GLEBE ROAD ARLINGTON, VA 22201-4714			EXAMINER BAUMEISTER, BRADLEY W	
			ART UNIT	PAPER NUMBER
			2815	
DATE MAILED: 02/10/2004				

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Applicati n No.

09/463,643

Applicant(s)

NAKAMURA ET AL.

Examiner

B. William Baumeister

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☐ Responsive to communication(s) filed on 17 November 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☐ Claim(s) 33,34,41-44,48-52 and 55-59 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☐ Claim(s) 33,34,41-44,48-52 and 55-59 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 25 January 2000 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Drawings*

1. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the second layer being composed of a single layer—as opposed to a superlattice—must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

### *Claim Rejections - 35 USC § 103*

2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

3. Claims 33, 34, 41, 48-50 and 55-57 are rejected under 35 U.S.C. 103(a) as being unpatentable over Itaya et al. '017 (previously made of record) in view of Bruno '604 (previously made of record). See the tenth embodiment of **FIG. 19** wherein Itaya teaches the employment of a doped (Al)GaN superlattice for injecting current to the active layer at low resistance by a pseudo two-dimensional electron gas (col. 24, lines 48-52). The embodiment includes an n-AlGaN clad 25. Itaya does not teach that the superlattice may include undoped wells.

a. Bruno teaches that (Al)GaN superlattices can be modulation-doped such that the dopant atoms are restricted to the barrier layers (col. 2, lines 59-60)--i.e., the GaN wells are undoped--for the purpose of reducing scattering and increasing mobility. It would

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have been obvious to one of ordinary skill in the art at the time of the invention to have provided a mod-doped superlattice for the superlattice 24 in the light emitter of Itaya for the purpose of reducing scattering and increasing mobility/reducing resistance as taught by Bruno.

b. As such, the 30 nm u-LT-AlGa<sub>N</sub> layer 22 reads on the buffer; the 0.3 micron u-HT-GaN layer 40 reads on the first layer; the 1.5 micron,  $1 \times 10^{18}$  n-doped AlGa<sub>N</sub> layer 23 reads on the second layer; and any one of the 50-angstrom GaN wells of superlattice 24 (such as the lowest one which is adjacent to the second, n-AlGa<sub>N</sub> layer 23)--when modified to be undoped according to Bruno--reads on the third layer.

c. Regarding claims 55, 56 and those depending therefrom all of which set forth that the first through third layers contact each other, first layer 40 contacts second layer 23. Also, Itaya discloses that the superlattice is composed of 50 pairs of wells and barriers (col. 24, lines 20-) indicating the well is formed first, and is therefor in contact with the second layer. However, even if the reference must be interpreted so narrowly as not sufficiently implying this fact, it would have been obvious to one of ordinary skill in the art at the time of the invention to have formed the well--as opposed to the barrier--first so as to be adjacent to the second layer because the barrier and the second layer are both composed of Al<sub>0.15</sub>Ga<sub>0.85</sub>N and placing a barrier adjacent to the second layer 23 would have such negligible effect as to not be necessary and thereby making the placement of the well adjacent the second layer more cost effective from a manufacturing standpoint.

d. Claims 41, 50 and 57 further requires that the third layer be composed of InGa<sub>N</sub>, and as such, the u-GaN well of Itaya/Bruno does not read on this limitation when

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interpreted as constituting the third layer. Nonetheless, it was well known to those of ordinary skill in the art at the time of the invention that InGaN has a smaller bandgap than GaN, and it was known by those skilled in the art how to form a (Al)GaN-barrier/InGaN-well superlattice. It would have been obvious to one of ordinary skill in the art at the time of the invention to have composed the mod-doped superlattice 24 of Itaya/Bruno with u-InGaN instead of u-GaN for the purpose of further improving upon the pseudo two-dimensional electron gas effects of the superlattice: reducing the well's effective bandgap to increase the carrier mobility/decrease the carrier resistance and thereby further increase the current injection into the active layer as desired by Itaya.

4. Claims 33, 34, 41-44, 48-52, and 55-59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iyechika et al. 077 in view of Itaya '017.

a. Iyechika discloses (see e.g., FIG 3) a nitride LED comprising substrate 8; n-type (Al)GaN clad 3; active layer 5; p-type contact layer 7; a three layer laminated structure 9, 1, 10 sandwiched by the substrate and the active layer, which three layers directly contact each other. The first layer 9 is composed of 30 nm u-GaN; the second layer 1 is composed of 2.5 um-thick, n-type GaN; and the third layer 10 is composed of 150 nm-thick u-GaN. Iyechika does not anticipate the claims because it does not further possess an additional "buffer layer" interposed between the substrate and the first u-GaN layer 9.

b. Itaya teaches various embodiments that employ a multi-layer buffer system. See e.g., FIG 19 wherein an LT-AlGaN buffer is interposed between a single-crystal GaN buffer 40 and substrate 21; and col. 16, lines 33-, stating that in FIGs 7A-C, a u-GaN



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buffer can be interposed between the n-GaN layer 403 and the AlGaN buffer 402. It would have been obvious to one of ordinary skill in the art at the time of the invention to have further added an additional AlGaN buffer layer between the GaN buffer 9 and sapphire substrate 8 of Iyechika for the purpose of further improving the resultant crystallinity of the overlying layers as taught by Itaya.

c. Regarding those claims that set forth that the third layer is composed of InGaN instead of having the same composition as the second layer (e.g., claims 41, 50 and 57), Iyechika also discloses an alternative embodiment, partially depicted in FIG 1, wherein the strained InGaN layer 2 is formed over and in direct contact with the n-doped, "second layer" 1. Further, the specification states that this InGaN or strained layer 2 may be undoped (col. 5, lines 1-8). As such, this structure reads on the third layer being composed of InGaN.

### *Response to Arguments*

5. Applicant's arguments filed 11/17/2003 have been fully considered but they are either not persuasive or alternatively are moot in light of the new grounds of rejection.

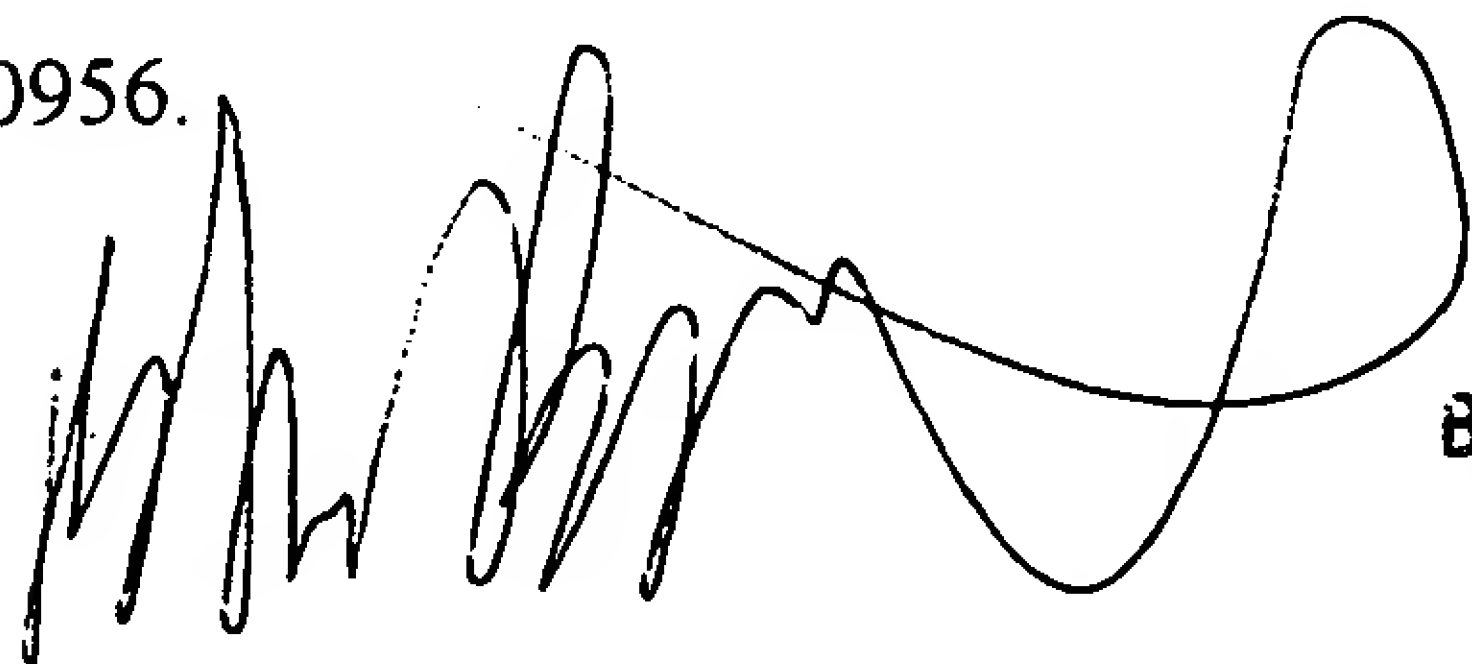
a. Applicant argues that the present invention is different from the one illustrated by Itaya in FIGs 12-19, but the illustration attached to the arguments does not correspond to the FIG 19 embodiment, which served as the base reference for the 103-obviousness rejection. Also, the arguments do not address why the claims are obvious when combined in the manner set forth in the rejection.

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**INFORMATION ON HOW TO CONTACT THE USPTO**

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to the examiner, **B. William Baumeister**, at **(571) 272-1722**. The examiner can normally be reached Monday through Friday, 8:30 a.m. to 5:00 p.m. If the Examiner is not available, the Examiner's supervisor, Mr. Tom Thomas, can be reached at (571) 272-1664. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-

0956.

A handwritten signature in black ink, appearing to read 'Bradley Baumeister', with a large loop at the end.

**BRADLEY BAUMEISTER  
PRIMARY EXAMINER**

B. William Baumeister

Primary Examiner, Art Unit 2815

February 6, 2004